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August 1999
Soil and Groundwater
Sampling Results
Frontier Hard Chrome
November 1999

URS Greiner

in association with

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White Shield, Inc.

AUGUST 1999 SOIL AND GROUNDWATER SAMPLING RESULTS

**FRONTIER HARD CHROME
VANCOUVER, WASHINGTON**

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**AUGUST 1999 SOIL AND GROUNDWATER SAMPLING RESULTS
FRONTIER HARD CHROME SUPERFUND SITE
VANCOUVER, WASHINGTON**

1. INTRODUCTION

This report presents the results of soil and groundwater sampling conducted at the Frontier Hard Chrome (FHC) Superfund site from 16-26 August 1999. The sampling effort was conducted to support treatability testing for *in situ* redox manipulation (IRSM) and to further characterize the source area of chromate in groundwater. Roy F. Weston, Inc. (WESTON®) prepared this report as a subcontractor under U.S. Environmental Protection Agency (EPA) Work Assignment No. 033-RI-CO-1027 to URS Greiner, Inc. The following sections present the field activities and analytical results for the soil and groundwater sampling conducted in August 1999. The report also presents a brief summary of historical soil analytical results for the site. Results from treatability testing of soil samples collected in August 1999 are not included in this report and will be submitted by others.

2. FIELD ACTIVITIES

Field activities were conducted in accordance with the procedures and methods specified in the Sampling and Analysis Plan (SAP) (WESTON 1997) and Revision 1 of SAP Addendum No. 6 (WESTON 1999). The services completed for this investigation consisted of collecting soil and groundwater samples for chemical analysis at 30 push-probes locations advanced at the site. Soil samples were submitted for chemical analyses of total recoverable iron, reducible iron, total recoverable chromium, and hexavalent chromium. Groundwater samples were submitted for chemical analysis of dissolved chromium and volatile organic compounds (VOCs). Details regarding field activities as well as sample results are presented below.

2.1 Push-Probe Explorations

The areal extent of the chromate source area was explored by advancing 30 push-probes at the locations shown in Figure 1; station GP-07 was sampled twice. All push-probes were advanced in the vicinity of the former FHC facility using a truck-mounted hydraulic push-probe rig operated by EPA's Environmental Services Assistant Team (ESAT) contractor. The push-probes were advanced to maximum depths of 18 to 29 feet below ground surface (bgs) through lithological units that were similar to those encountered at the facility in previous investigations: construction and hydraulic fill units, underlain by a silt/clay unit, which was in turn underlain by the "A" zone aquifer. Information regarding soil and groundwater sampling field activities and results are presented below.

2.2 Soil Sampling and Analysis

Continuous soil samples for lithological description were collected from the ground surface to the top of the "A" zone aquifer at nine of the sampling locations advanced during the field

activities (i.e., GP-02, GP-05, GP-06, GP-07, GP-10, GP-11, GP-12, GP-22, and GP-26) (Figure 1). Non-continuous soil samples were logged from the remaining push-probe locations to identify the target groundwater sampling intervals. Soil samples were collected with an acetate-lined, 4-foot-long, push-probe soil sampler driven by a hydraulic hammer. The sampling was conducted under the supervision of a WESTON geologist who visually logged the soils in general accordance with the Unified Soil Classification System as described in ASTM D-2499-69. Detailed logs of the subsurface soil explorations are presented in Appendix A.

Soil samples for laboratory analyses were collected from the bottom of the fill unit and the top of the silt unit at all 9 locations presented above. The contact between the fill and silt units was typically encountered from 12 to 17 feet bgs (Table 1). Fill and silt samples were submitted for iron, chromium, and hexavalent chromium chemical analyses.

In addition, larger (2-gallon) soil samples from the top of the “A” zone aquifer and from the construction fill and hydraulic fill units were also collected to support the treatability study. Soil samples collected from the “A” zone source area (GP-06 and GP-07), “A” zone downgradient area (GP-22 and GP-23), construction fill (GP-07), and hydraulic fill (GP-02) were submitted for reducible iron analyses (Table 2). The top of the “A” zone aquifer was typically encountered from 16 to 22 feet bgs (see Table 1). Details regarding the fill units are presented in Section 3.1.

Iron, chromium, and hexavalent chromium laboratory analyses were performed by EPA’s Manchester laboratory. Samples for reducible iron analyses were submitted to the Pacific Northwest National Laboratory operated by Battelle. Laboratory data quality assurance/quality control reports and laboratory data sheets are provided in Appendix B.

2.3 Groundwater Sampling and Analysis

Groundwater samples were collected at 30 push-probe locations (Figure 1). In accordance with the methods presented in the SAP (Weston 1999), groundwater samples were collected from a push-probe groundwater sampler with a 4-foot-screen interval and driven by a hydraulic hammer. Groundwater sampling was conducted by a WESTON geologist using a peristaltic pump with dedicated polyethylene tubing. Water quality parameters (dissolved oxygen [DO], pH, and temperature) were measured in the field using hand held instruments, a flow-through cell (for DO), and a beaker (for pH and temperature) at sampling horizons that produced adequate groundwater volume. Water quality parameter measurements are presented in Table 3.

Groundwater samples for laboratory analyses were collected from two horizons: the perched zone (at the bottom of the fill unit) and the top of the “A” zone aquifer. Samples from the perched zone were collected at 17 of the push-probe locations, where groundwater was sometimes encountered above the contact between the fill and the underlying silt unit. Eleven samples were collected from hydraulic fill and six samples were collected from construction fill. At the remaining 12 sampling locations there was inadequate perched groundwater to sample. Sampling depths from the perched zone ranged from 8 to 13 feet bgs. Groundwater samples from the “A” zone aquifer were collected at all 30 push-probe locations. Sampling depths from the “A” zone aquifer ranged from 16 to 24 feet bgs.

All groundwater samples collected were submitted for dissolved chromium and VOC analyses (Table 4). Dissolved chromium samples were field filtered with a 0.45-micron in-line filter and collected directly from the peristaltic pump and dedicated polyethylene tubing. After collecting the dissolved chromium samples, groundwater samples for VOC analyses were collected from the volume of water pumped into the polyethylene tubing (before it passed through the peristaltic pump). The samples were collected by pulling the dedicated polyethylene tubing full with groundwater from the sampling point and emptying its volume into the appropriate sampling containers.

All inorganic laboratory analyses were performed by EPA's Manchester laboratory. All groundwater samples were analyzed for selected VOCs (i.e., cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, and tetrachloroethene) at a mobile field laboratory located at the site and operated by EPA's ESAT contractor. Replicates of approximately 25 percent of the VOC samples were submitted to EPA's Manchester laboratory for confirmation analysis. Laboratory data quality assurance/quality control reports and laboratory data sheets are presented in Appendix B.

3. RESULTS

3.1 Subsurface Soil Conditions

The soil units encountered in the borings were similar in nature and distribution to those observed in previous investigations. A summary of the geological data obtained from the push-probes is presented in Table 1. The uppermost unit encountered during the investigation consisted of two types of fill material: construction and hydraulic fill. Construction fill is typically found east of the former FHC building while hydraulic fill is typically located beneath and west of the building. The approximate location of the boundary between the two fill types as defined from field activities is presented in Figure 2. Construction fill material consists of reddish to dark brown sand with silt and basaltic gravel, with concrete, brick, metal, asphalt, nails, plastic, and newspaper debris. Hydraulic fill material consists of micaceous, dark brown to olive gray sand with occasional traces of silt and/or gravel. Based on field observations, the fill units (both construction and hydraulic fills) range from 4.5- to 18-feet in thickness.

Underlying the fill unit is the silt unit consisting of dark brown to olive gray, highly plastic, clayey silt with varying amounts of sand, gravel, and root fragments, and ranging between 3.5- to 6-feet thick. Some iron oxide staining is commonly found along the root traces. Perched groundwater, when present, was more frequently encountered within the hydraulic fill than within the construction fill. Beneath the silt unit is the "A" zone, an alluvial unit consisting of reddish to greenish brown sand with silt and basalt gravel. The bottom of the "A" zone aquifer was not encountered in any of the push-probes advanced.

3.2 Water Quality Parameter Field Measurements

Dissolved oxygen (DO), pH, and temperature field measurements are summarized in Table 3. DO concentrations in perched zone groundwater samples ranged from 1.0 mg/L to 4.4 mg/L,

with an average of 2.3 mg/L. DO concentrations in “A” zone aquifer samples ranged from 1.0 mg/L to 4.0 mg/L, with an average of 2.0 mg/L. pH measurements in perched zone samples ranged from 5.7 to 7.2, with an average of 6.5. The lowest pH measurements in perched groundwater were from sample stations inside and north of the former FHC building. pH measurements in “A” zone aquifer samples ranged from 6.4 to 7.3, with an average of 6.6. Temperature measurements in perched zone samples ranged from 15.6°C to 18.6°C, with an average of 17.6°C. Temperature measurements in “A” zone aquifer samples ranged from 14.7°C to 20.3°C, with an average of 16.3°C.

3.3 Chemical Analysis

Laboratory data quality assurance/quality control reports and laboratory data sheets are provided in Appendix B.

3.3.1 Soil

Soil analysis results for hexavalent chromium, total recoverable chromium, and total recoverable iron are summarized in Table 5.

Hexavalent chromium was detected in 82 percent of the soil samples at concentrations ranging from 19.7 mg/kg to 7,506 mg/kg. The highest concentrations of hexavalent chromium were at stations GP-26 and GP-06, located inside the former FHC building and immediately east of the building, respectively. Hexavalent chromium was not detected in either the fill or silt unit samples at station GP-02 located north of the former FHC building, or in the silt unit sample at GP-07 located adjacent to the former dry well. The distribution of hexavalent chromium in the fill and silt units is shown in Figures 2 and 3, respectively.

Total recoverable chromium is the sum of all forms of chromium including trivalent and hexavalent chromium. Total chromium was detected in all of the soil samples at concentrations ranging from 25.4 mg/kg to 31,800 mg/kg. The areal distribution of total chromium concentrations in soil was similar in pattern to the distribution of hexavalent chromium concentrations.

Iron was detected in all of the soil samples at concentrations ranging from 10,600 mg/kg to 40,400 mg/kg.

Concentrations of hexavalent chromium, total recoverable chromium, and total recoverable iron were consistently higher in the silt unit than in the fill unit.

3.3.2 Groundwater

Groundwater analysis results for filtered chromium and iron are summarized in Table 6. Groundwater VOC analysis results for samples analyzed by the ESAT mobile field laboratory are summarized in Table 7. Confirmation VOC analytical results are summarized in Table 8. A comparison of field laboratory and confirmation sample VOC analytical results is provided in Table 9; the comparison confirms that the field laboratory VOC analyses are adequately precise and accurate.

3.3.2.1 Perched Zone

Chromium was detected at all but 2 of the 17 perched zone groundwater sample stations at concentrations ranging from 5.7 µg/L to 48,700 µg/L. The highest concentrations of chromium were at stations GP-06 and GP-12, located immediately southeast of the former FHC building. Chromium was not detected at GP-02 or GP-25, located north of the former FHC building and near the pump station along East 1st Avenue, respectively. The distribution of chromium in the perched zone is shown in Figure 4.

Iron was detected in all of the perched zone groundwater samples at concentrations ranging from 16 µg/L to 1,020 µg/L.

Tetrachloroethene (PCE) was detected in all perched groundwater samples except GP-14, at concentrations ranging from 0.08 µg/L to 20 µg/L; the highest PCE concentration was detected at GP-06. Trichloroethene (TCE) was detected in all perched groundwater samples except GP-02 and GP-14, at concentrations ranging from 0.06 µg/L to 2.3 µg/L; the highest TCE concentration was detected at GP-07. Cis-1,2-Dichloroethene (cDCE) was detected at six perched groundwater sample stations at concentrations ranging from 1.1 µg/L to 6 µg/L; the highest cDCE concentration was detected at GP-07. Trans-1,2-Dichloroethene (tDCE) was not detected at any perched groundwater sample stations. In addition to the above VOCs; 1,1,1-trichloroethane and 1,1-dichloroethane were also detected in the one confirmatory perched zone groundwater sample analyzed for the full suite of VOCs, at concentrations of 0.18 µg/L and 0.38 µg/L, respectively.

3.3.2.2 “A” Zone Aquifer

Chromium was detected at 18 out of 30 “A” zone groundwater sample stations at concentrations ranging from 6.8 µg/L to 119,000 µg/L. The highest concentrations of chromium were at stations GP-26, GP-06, and GP-12, located inside and immediately southeast of the former FHC building. Chromium was not detected in the “A” zone aquifer at stations located north and west of the former FHC building. The distribution of chromium in the “A” zone aquifer is shown in Figure 5.

Iron was detected at all of the “A” zone aquifer groundwater sample stations at concentrations ranging from 11 µg/L to 64,600 µg/L.

PCE was detected at 23 out of 30 “A” zone aquifer groundwater stations at concentrations ranging from 0.037 µg/L to 14 µg/L; the highest PCE concentration was detected at GP-06. TCE was detected at 24 “A” zone sample stations at concentrations ranging from 0.04 µg/L to 5.4 µg/L; the highest TCE concentration was detected at GP-28. cDCE was detected at 11 stations at concentrations ranging from 0.97 µg/L to 39 µg/L; the highest cDCE concentration was detected at GP-28. tDCE was detected at two “A” zone sample stations: GP-07 (1.2 µg/L) and GP-28 (2.2 µg/L).

In addition to the above VOCs: 1,1,1-trichloroethane (TCA); 1,1-dichloroethane (DCA); and trichloromethane were also detected in one or more of the 8 confirmatory “A” zone groundwater

samples analyzed for the full suite of VOCs. Detected TCA concentrations ranged from 0.36 µg/L to 5.0 µg/L. Detected DCA concentrations ranged from 0.17 µg/L to 2.4 µg/L. Trichloromethane was detected only in GP-23 at an estimated concentration of 0.12 µg/L.

4. HISTORICAL SUBSURFACE SOIL RESULTS

Hexavalent chromium analytical results for historical subsurface soil samples collected at FHC are presented to facilitate comparison of the August 1999 results with previous sampling results. Historical subsurface soil sampling locations are presented in Figure 6. Figures 7, 8, and 9 present the distribution of hexavalent chromium from historical soil samples for the fill, silt, and “A” zone aquifer units, respectively. Historical results are presented from the following studies: Dames and Moore, 1987; ICF Technology, 1993; Radian, 1991; and WESTON, 1999. The chromium concentrations were not contoured due to the extended time period over which the samples were collected.

5. REFERENCES

Dames and Moore, Inc. 1987. Remedial Investigation - Frontier Hard Chrome. Final Report (Volumes 1 and 2). Prepared for the Washington State Department of Ecology.

ICF Technology. 1993. Soil Analysis Report, Frontier Hard Chrome. Prepared for U.S. EPA.

Radian Corporation. 1991. Design Analysis Report, Frontier Hard Chrome. Prepared for U.S. Army Corps of Engineers.

WESTON (Roy F. Weston, Inc.). 1999. Revision 1, Sampling and Analysis Plan Addendum No. 6, Frontier Hard Chrome, Vancouver, Washington. Prepared for U.S. EPA Region X by Roy F. Weston, Inc., Seattle, Washington.

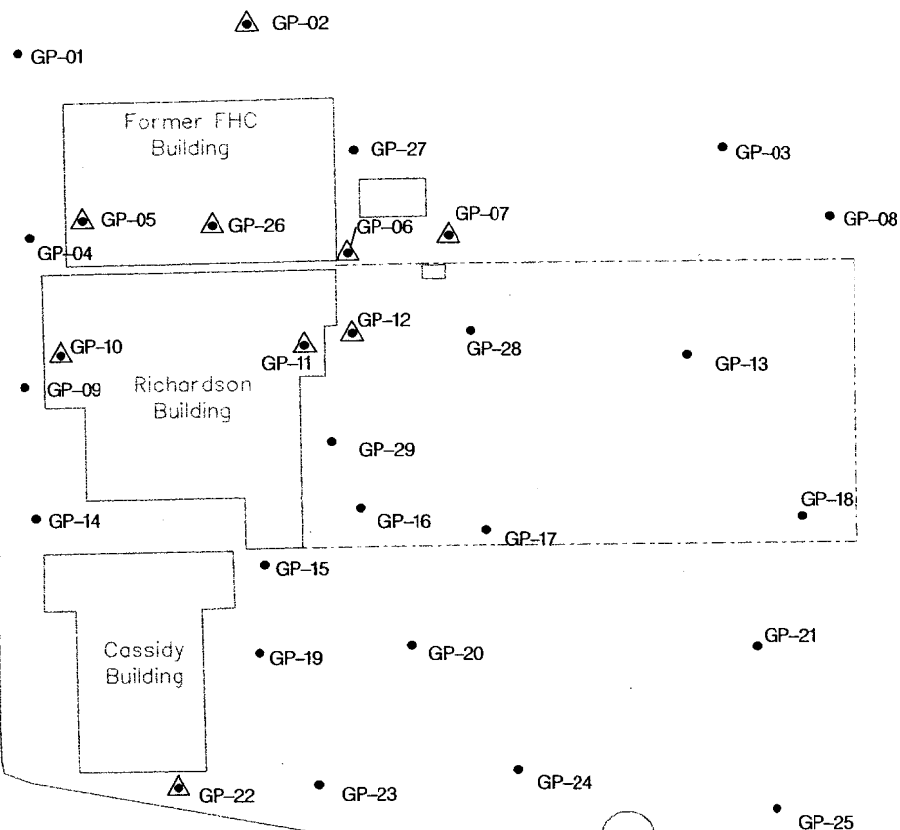
WESTON. 1999. Site Conditions Technical Memorandum, June 1998 Soil Sampling Results, Frontier Hard Chrome, Vancouver, Washington. Prepared for U.S. EPA Region X by Roy F. Weston, Inc., Seattle, Washington.

WESTON. 1997. Sampling and Analysis Plan, Frontier Hard Chrome Remedial Design, Vancouver, Washington. Prepared for U.S. EPA Region X by Roy F. Weston, Inc., Seattle, Washington.

FIGURES

EXPLANATION

- August 1999 Push-probe
Groundwater Exploration
- ▲ August 1999 Push-probe
Soil and Groundwater Exploration



WESTON
MANAGERS DESIGNERS/CONSULTANTS



0 25 50
Scale in Feet

Frontier Hard Chrome
August 1999 Groundwater
and Subsurface Soil
Sample Locations

FIGURE
1

EXPLANATION

34.0

- Hexavalent Chromium Concentration (mg/kg)

u = Not detected at given detection limit.

WESTON
MANAGERS DESIGNERS/CONSULTANTS

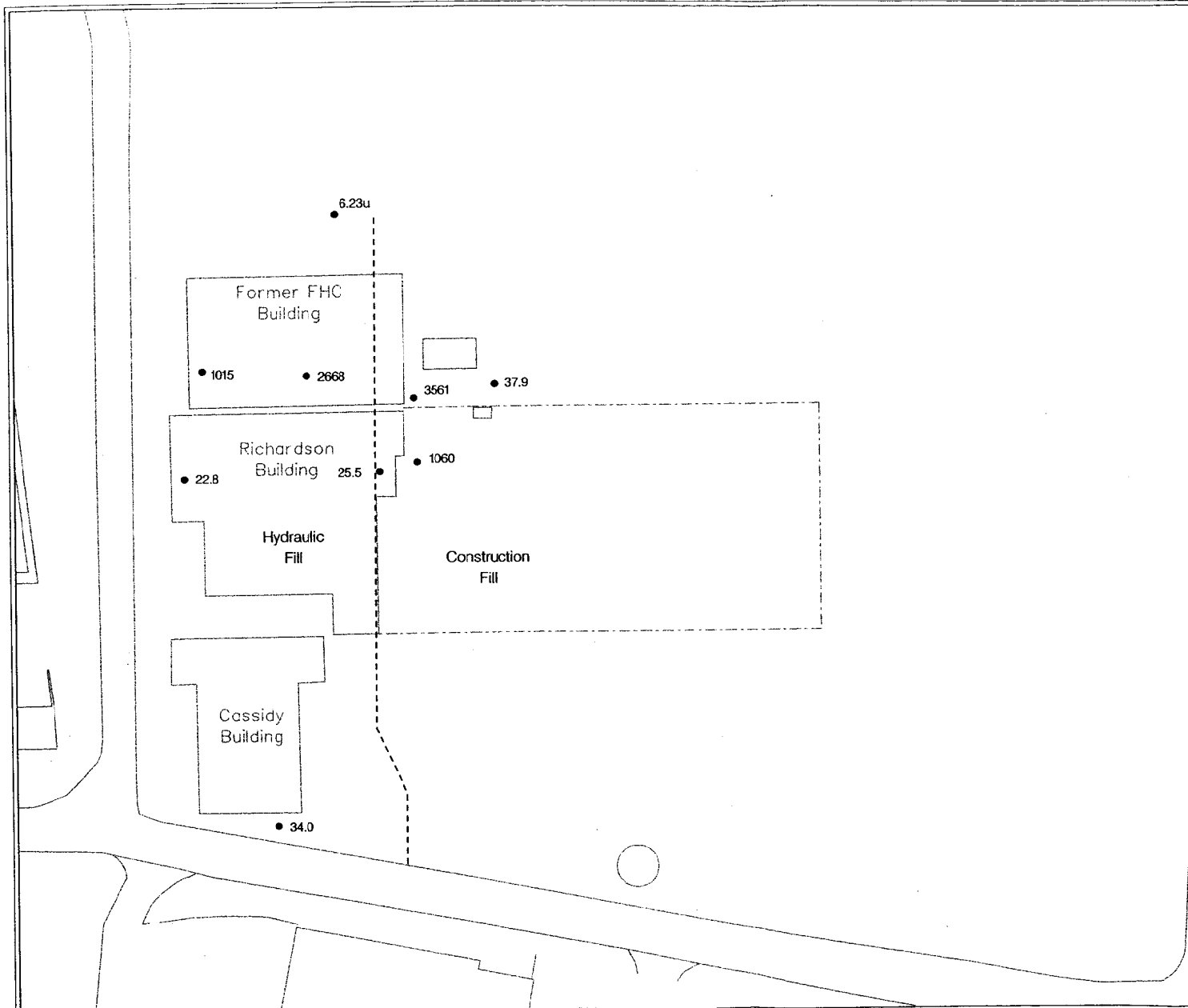


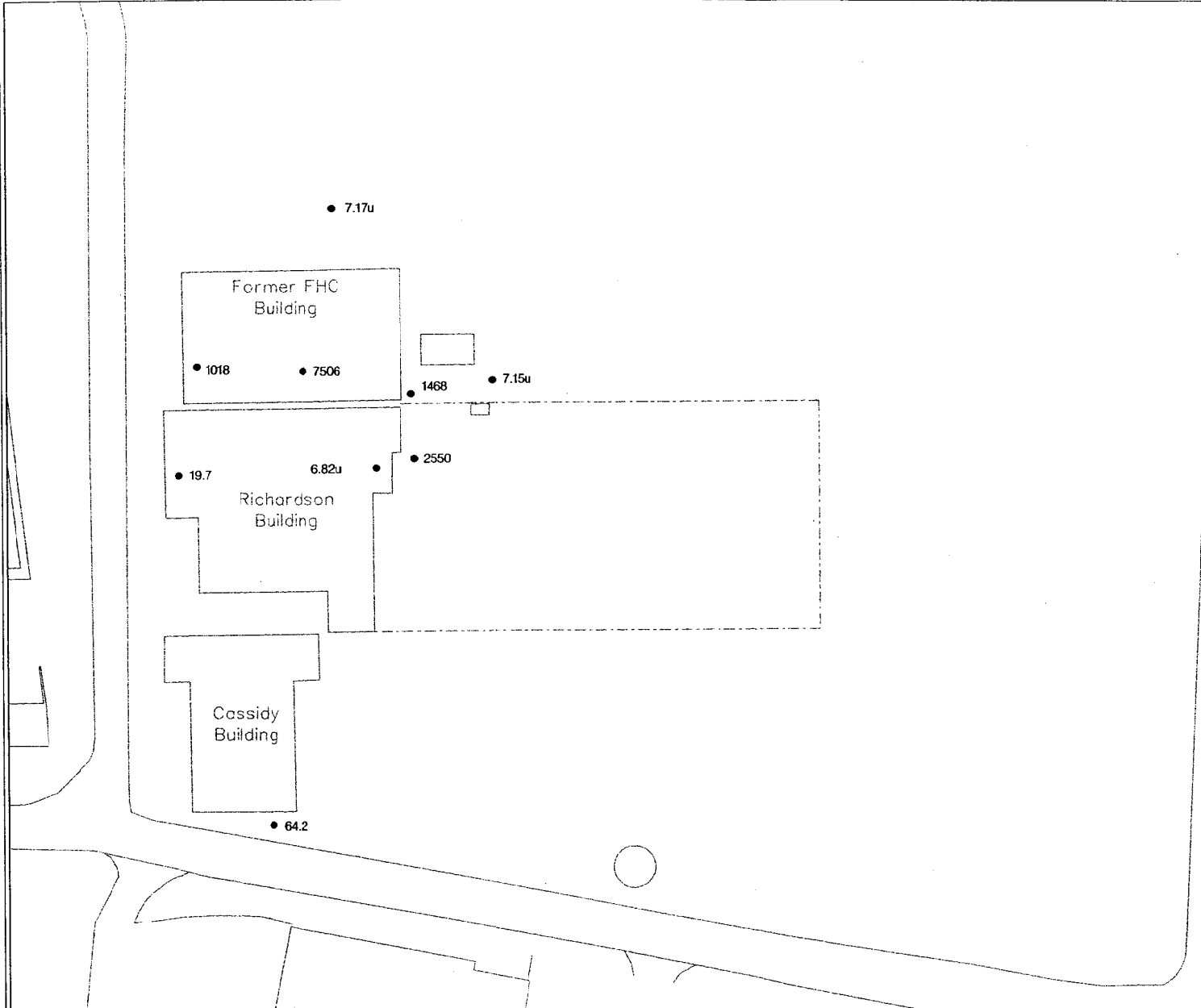
0 25 50
Scale in Feet

Frontier Hard Chrome
August 1999
Concentrations of
Hexavalent Chromium
in Fill Soil

FIGURE

2





EXPLANATION

- 34.0
 • Hexavalent Chromium Concentration (mg/kg)

u = Not detected at given detection limit.

WESTON
 MANAGERS DESIGNERS/CONSULTANTS



0 25 50
 Scale in Feet

Frontier Hard Chrome
 August 1999
 Concentrations of
 Hexavalent Chromium
 in Silt Layer Soil

FIGURE

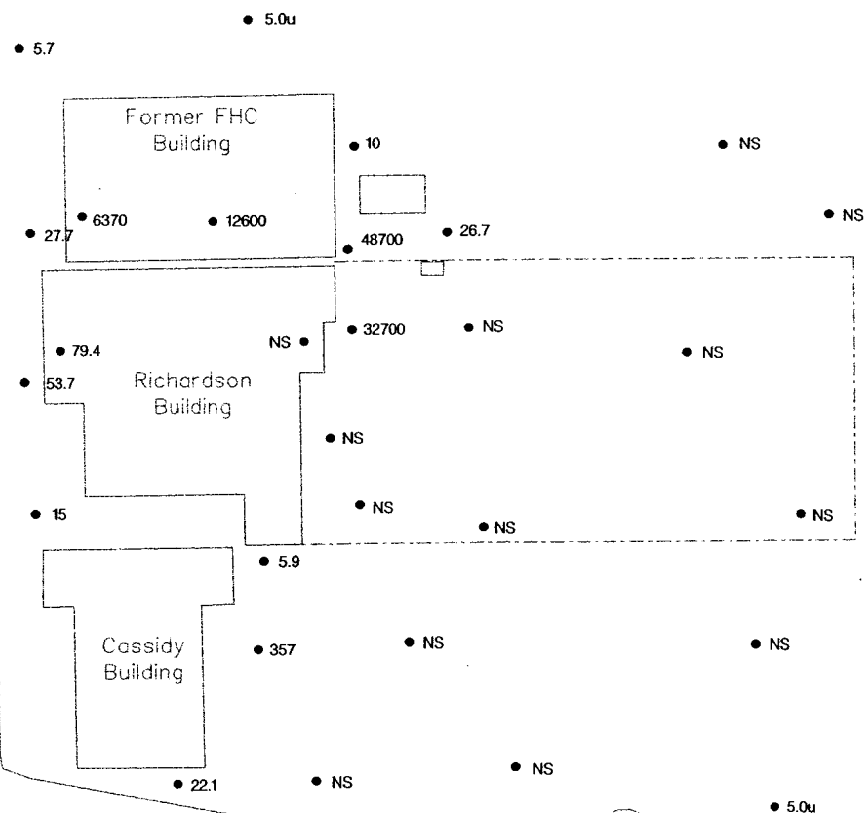
3

EXPLANATION

357
● Filtered Total Chromium
Concentration (ug/L)

NS - No Sample

u - Not detected at given
detection limit



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0 25 50
Scale in Feet

Frontier Hard Chrome
August 1999
Concentrations of
Filtered Total Chromium
in Perched Zone
Groundwater

FIGURE

4

EXPLANATION

277
● Filtered Total Chromium
Concentration (ug/L)

u - Not detected at given
detection limit

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MANAGERS DESIGNERS/CONSULTANTS

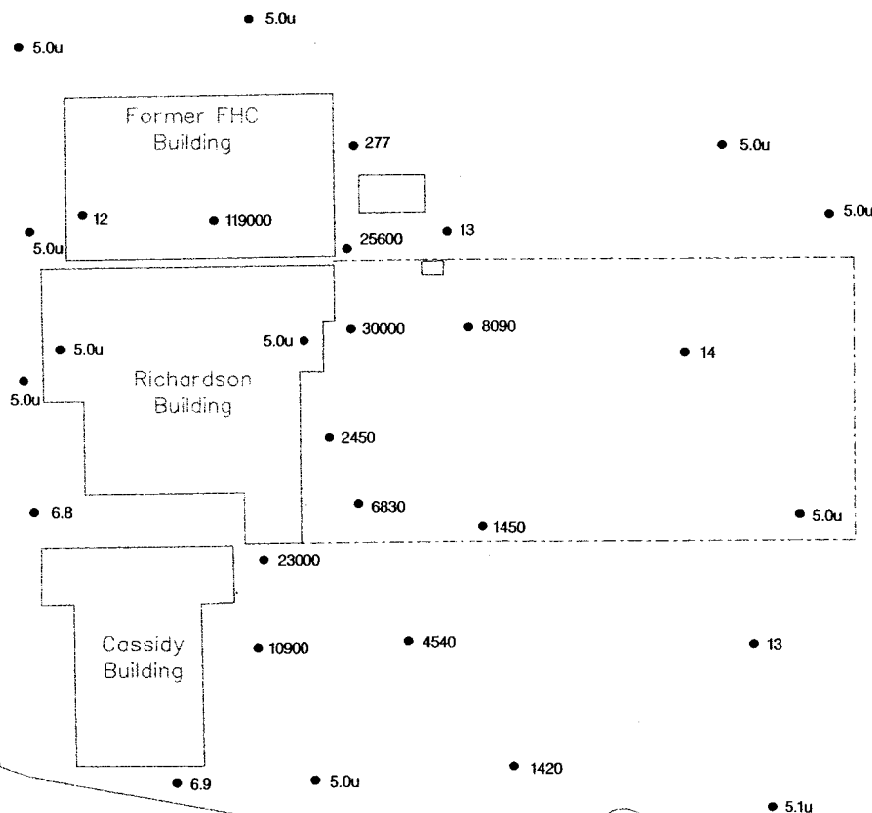


0 25 50
Scale in Feet

Frontier Hard Chrome
August 1999
Concentrations of
Filtered Total Chromium
in "A" Zone Groundwater

FIGURE

5



- RSB-2 Historical Subsurface Soil Exploration
- GP-03 August 1999 Push-probe Subsurface Exploration



0 25 50
Scale in Feet

Frontier Hard Chrome Historical Subsurface Soil Sample Locations

FIGURE

6

EXPLANATION

2.5 Hexavalent Chromium
• Concentration (mg/kg)

u - Not detected at given
detection limit

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0 25 50
Scale in Feet

Frontier Hard Chrome
Historical Concentrations
of Hexavalent Chromium
in Fill Soil

FIGURE

7



EXPLANATION

- 1.6 Hexavalent Chromium
 • Concentration (mg/kg)

u - Not detected at given
 detection limit

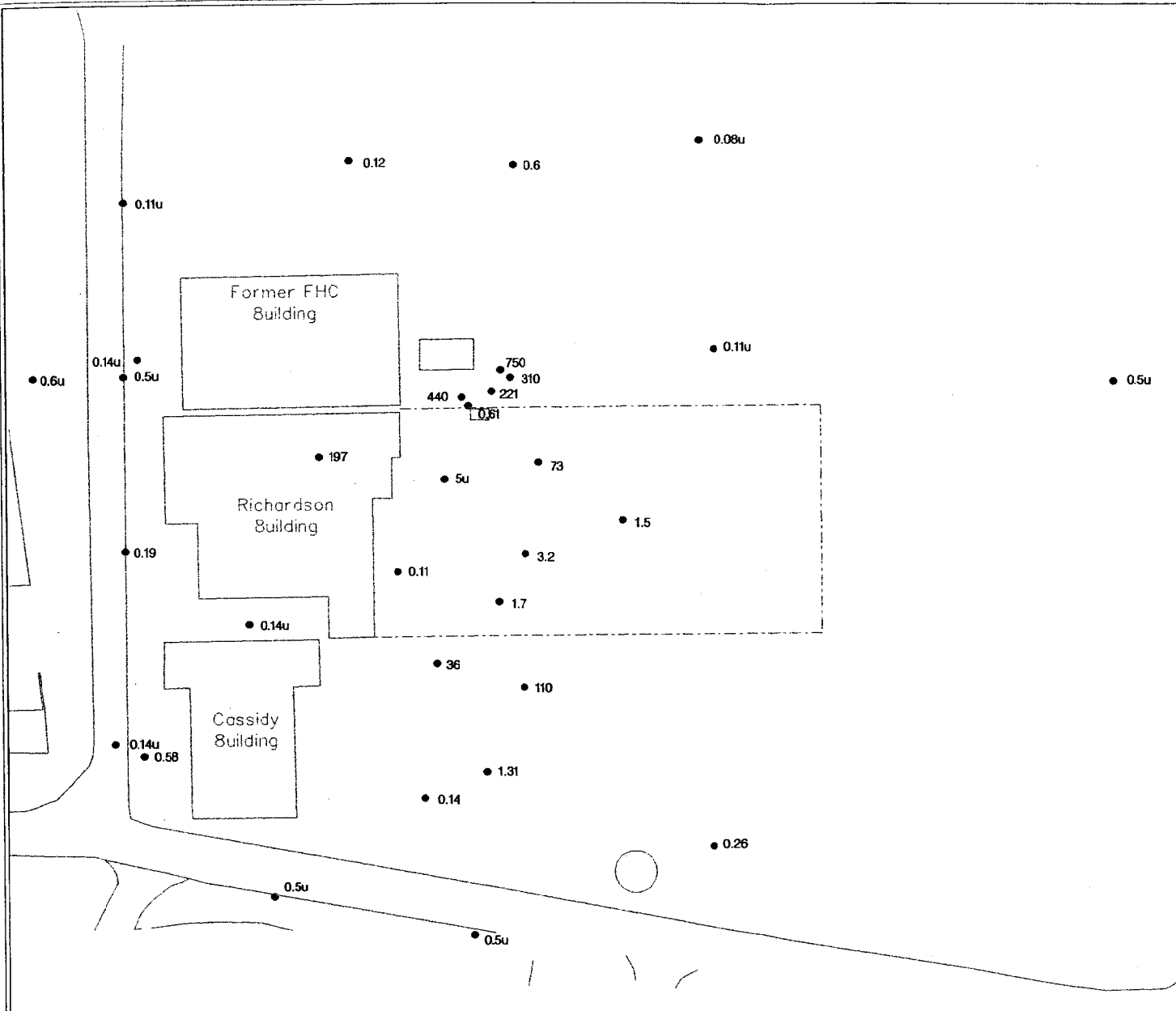
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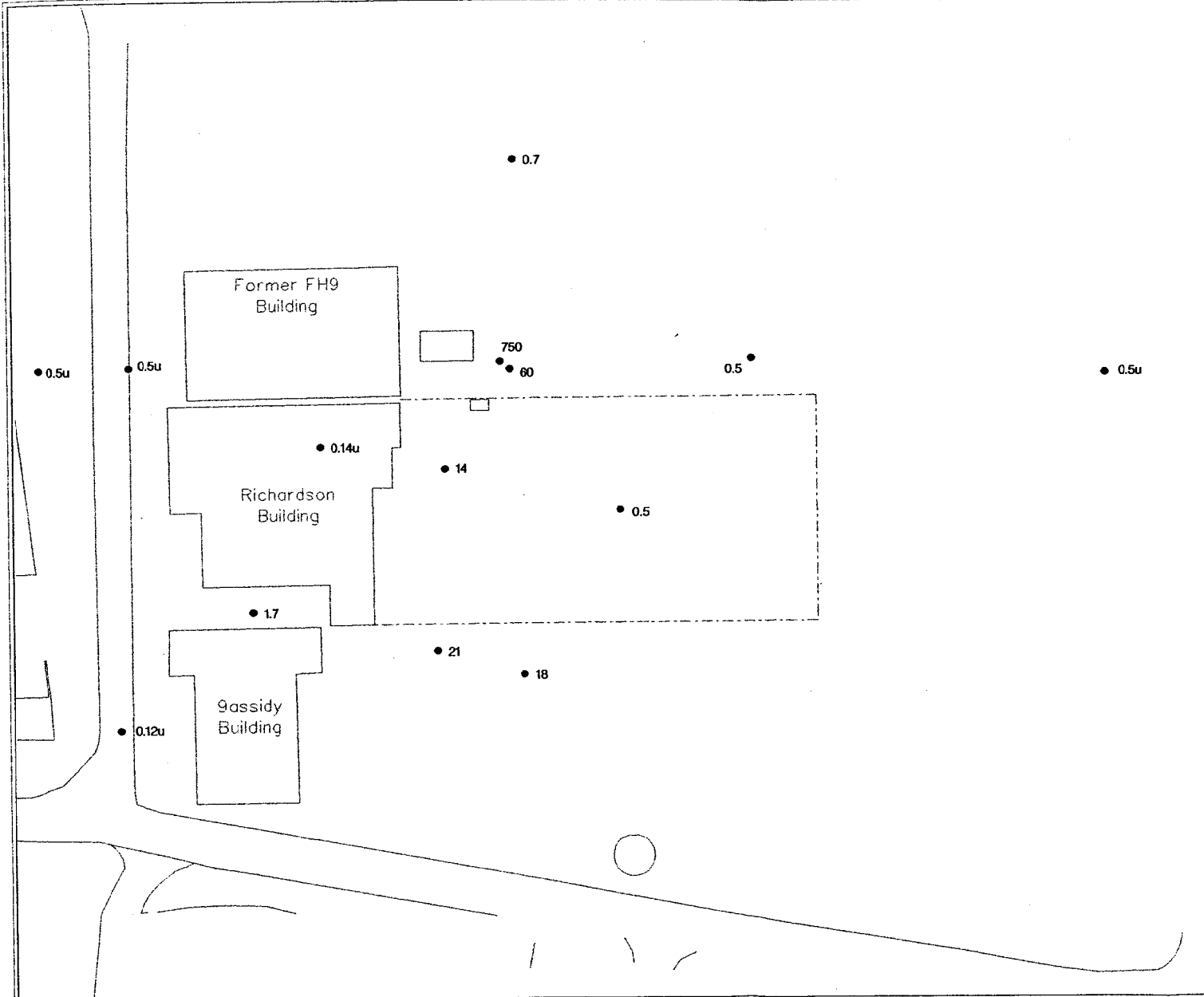


0 25 50
 Scale in Feet

Frontier Hard Chrome
 Historical Concentrations
 of Hexavalent Chromium
 in Silt Layer Soil

FIGURE
8





EXPLANATION

0.7
● Hexavalent Chromium
Concentration (mg/kg)

u - Not detected at given
detection limit

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0 25 50
Scale in Feet

Frontier Hard Chrome
Historical Concentrations
of Hexavalent Chromium
in "A" Zone Soil

FIGURE

9

TABLES

Table 1—Frontier Hard Chrome—Depths of Soil Units Encountered (Feet BGS)

Station ID	Type of Fill	Fill		Silt		"A" Zone Top	Maximum Depth Explored
		Top	Bottom	Top	Bottom		
GP-01	Hydraulic	0	NL	NL	NL	NL	26
GP-02	Hydraulic	0	15.75	15.75	19.75	19.75	26
GP-03	Construction	0	12	12	NL	NL	28
GP-04	Hydraulic	0	NL	NL	NL	NL	26
GP-05	Hydraulic	0	17	17	21.5	21.5	26
GP-06	Construction	0	16	16	21	21	26
GP-07	Construction	0	15.5	15.5	19	19	24
GP-08	Construction	0	13	13	NL	NL	28
GP-09	Hydraulic	0	NL	NL	NL	NL	26
GP-10	Hydraulic	0	16.5	16.5	21	21	28
GP-11	Construction	0	18	18	NL	NL	26
GP-12	Construction	0	15.5	15.5	20	20	26
GP-13	Construction	0	14.5	14.5	NL	NL	28
GP-14	Hydraulic	0	NL	NL	NL	NL	26
GP-15	Hydraulic	0	10.5	10.5	NL	NL	28
GP-16	Construction	0	NL	NL	NL	NL	25.5
GP-17	Construction	0	15.5	15.5	NL	NL	28
GP-18	Construction	0	11	11	16-18	16-18	18
GP-19	Hydraulic	0	12.5	12.5	NL	NL	28
GP-20	Construction	0	12.5	12.5	NL	NL	28
GP-21	Construction	0	4.5	4.5	17?	17	26
GP-22	Hydraulic	0	13	13	19	19	22
GP-23	Hydraulic	0	10	10	NL	NL	28
GP-24	Construction	0	NL	NL	NL	NL	28
GP-25	Construction	0	7.5	7.5	20	20	29
GP-26	Hydraulic	0	17.5	17.5	22	22	26
GP-27	Construction	0	16.5	16.5	NL	NL	28
GP-28	Construction	0	13	13	NL	NL	28
GP-29	Construction	0	13.5	13.5	NL	NL	28

Notes:

BGS: Below ground surface

NL: Soil unit contact not logged

Table 2—Frontier Hard Chrome—Soil Sampling Analyses Summary

WESTON Sample ID	EPA Sample ID	Sample Time	Sample Date	Total Chromium	Hexavalent Chrome	Total Iron	Reducible Iron
				EPA Method			
				6010	3060A / 7196A	6010	Battelle SOP
GP-02 - 0-P	99344163	0800	18-Aug-99	X	X	X	
GP-02 - 0-S	99344164	0803	18-Aug-99	X	X	X	
GP-05 - 0-P	99354055	1145	22-Aug-99	X	X	X	
GP-05 - 0-S	99354056	1149	22-Aug-99	X	X	X	
GP-06 - 0-P	99344154	0847	17-Aug-99	X	X	X	
GP-06 - 0-S	99344155	0849	17-Aug-99	X	X	X	
GP-06 - 0035	99344162	0840	17-Aug-99	X	X	X	
GP-07 - 0-P	99344150	1204	16-Aug-99	X	X	X	
GP-07 - 0-S	99344151	1207	16-Aug-99	X	X	X	
GP-10 - 0-P	99354062	1620	22-Aug-99	X	X	X	
GP-10 - 0-S	99354063	1628	22-Aug-99	X	X	X	
GP-11 - 0-P	99354059	1445	22-Aug-99	X	X	X	
GP-11 - 0-S	99354060	1449	22-Aug-99	X	X	X	
GP-12 - 0-P	99344171	1600	18-Aug-99	X	X	X	
GP-12 - 1-P	99344172	1605	18-Aug-99	X	X	X	
GP-12 - 0-S	99344173	1607	18-Aug-99	X	X	X	
GP-22 - 0-P	99344158	NA	17-Aug-99	X	X	X	
GP-22 - 0-S	99344159	NA	17-Aug-99	X	X	X	
GP-26 - 0-P	99354050	0820	22-Aug-99	X	X	X	
GP-26 - 0-S	99354051	0825	22-Aug-99	X	X	X	
GP-26 - 1-P	99354052	0829	22-Aug-99	X	X	X	
RICF - 0-P	99354090	NA	16-Aug-99				GP-07
RIHF - 0-P	99354089	NA	18-Aug-99				GP-02
RIDA - 0-A	99354091	NA	17-Aug-99				GP-22 & GP-23
RISA - 0-A	99354092	NA	22-Aug-99				GP-06 & GP-07

Notes:

NA: Not applicable

Table 3—Frontier Hard Chrome—Groundwater Field Measurements

Station ID*	Dissolved Oxygen (mg/L)	pH	Temperature (°C)
GP-01 P	1.0	7.2	NM
GP-01 A	2.9	6.4	NM
GP-02 P	1.1	5.9	15.6
GP-02 A	NM	NM	NM
GP-03 A	2.8	6.7	17.2
GP-04 P	2.5	6.3	15.7
GP-04 A	1.0	6.4	14.9
GP-05 P	1.7	5.8	16.6
GP-05 A	NM	NM	NM
GP-06 P	2.0	6.2	NM
GP-06 A	1.6	6.5	NM
GP-07 P (1st)	NM	NM	NM
GP-07 A (1st)	NM	NM	NM
GP-07 P (2nd)	2.7	7.0	18.6
GP-07 A (2nd)	2.2	6.8	15.8
GP-08 A	2.2	6.6	15.7
GP-09 P	2.0	7.0	16.2
GP-09 A	1.2	6.5	15.5
GP-10 P	NM	NM	NM
GP-10 A	NM	NM	NM
GP-11 A	NM	NM	NM
GP-12 P	1.0	6.1	15.7
GP-12 A	NM	NM	NM
GP-13 A	1.8	6.8	20.3
GP-14 P	4.4	7.1	18.2
GP-14 A	NM	7.1	19.6
GP-15 P	2.2	6.5	18.6
GP-15 A	1.6	6.6	19.6
GP-16 A	4.0	6.4	1.7
GP-17 A	1.6	6.5	18.3
GP-18 A	2.0	7.3	16.3
GP-19 P	2.0	6.4	18.5
GP-19 A	1.7	6.4	18.1
GP-20 A	NM	NM	NM
GP-21 A	1.1	6.7	16.2
GP-22 P	2.3	6.4	NM
GP-22 A	NM	NM	NM
GP-23 A	2.5	6.6	17.4
GP-24 A	1.9	6.4	17.7
GP-25 A	1.2	6.8	14.7
GP-26 P	1.5	5.7	15.8
GP-26 A	NM	NM	NM
GP-27 P	2.2	7.0	18.1
GP-27 A	NM	NM	NM
GP-28 A	NM	NM	NM
GP-29 A+A17	2.8	6.6	17.6

Notes:

* GP-01 P = Sample from perched groundwater zone at station GP-01; GP-01 A = sample from "A" aquifer zone at station GP-01

NM: Not measured

Table 4—Frontier Hard Chrome—Groundwater Sampling Analysis Summary

WESTON Sample ID	EPA Sample ID	Time	Date	Selected Volatile Organic Compounds	Dissolved Chromium and Iron	Volatile Organic Compounds
				Region 10 ESAT SOP #FASP-041	EPA Method 6010	EPA Method 8260A
GP-01 - 0-P	99344167	1050	18-Aug-99	X	X	
GP-01 - 0-A	99344168	1110	18-Aug-99	X	X	
GP-02 - 0-P	99344165	840	18-Aug-99	X	X	
GP-02 - 0-A	99344166	938	18-Aug-99	X	X	
GP-03 - 0-A	99354081	1015	25-Aug-99	X	X	
GP-04 - 0-P	99344176	840	18-Aug-99	X	X	
GP-04 - 0-A	99344177	940	19-Aug-99	X	X	
GP-05 - 0-P	99354057	1115	22-Aug-99	X	X	
GP-05 - 0-A	99354058	1150	22-Aug-99	X	X	
GP-06 - 0-P	99344156	900	17-Aug-99	X	X	
GP-06 - 0-A	99344157	1001	17-Aug-99	X	X	
GP-07 - 0-P	99344152	1207	16-Aug-99	X	X	
GP-07 - 0-A	99344153	1420	16-Aug-99	X	X	
GP-07 - 0-P	99354082	1235	25-Aug-99	X	X	
GP-07 - 0-A	99354083	1305	25-Aug-99	X	X	
GP-08 - 0-A	99354080	850	25-Aug-99	X	X	X
GP-09 - 0-P	99344178	1030	19-Aug-99	X	X	
GP-09 - 0-A	99344179	1100	19-Aug-99	X	X	
GP-10 - 0-P	99354064	1710	22-Aug-99	X	X	X
GP-10 - 0-A	99354065	1825	22-Aug-99	X	X	
GP-11 - 0-A	99354061	1515	22-Aug-99	X	X	
GP-12 - 0-P	99344174	1630	18-Aug-99	X	X	
GP-12 - 0-A	99344175	1730	18-Aug-99	X	X	
GP-13 - 1-A	99354074	1545	23-Aug-99	X	X	
GP-13 - 0-A	99354073	1540	23-Aug-99	X	X	
GP-14 - 0-P	99344180	1300	19-Aug-99	X	X	
GP-14 - 0-A	99344181	1404	19-Aug-99	X	X	X
GP-15 - 0-P	99354070	1300	23-Aug-99	X	X	
GP-15 - 1-A	99354071	1350	23-Aug-99	X	X	
GP-15 - 0-A	99354072	1359	23-Aug-99	X	X	
GP-16 - 1-A	99344183	1110	20-Aug-99	X	X	
GP-16 - 0-A	99344184	1150	20-Aug-99	X	X	X
GP-17 - 0-A	99354079	1450	24-Aug-99	X	X	X
GP-18 - 0-A	99344185	1520	20-Aug-99	X	X	
GP-19 - 0-P	99354068	1010	23-Aug-99	X	X	
GP-19 - 0-A	99354069	1055	23-Aug-99	X	X	X
GP-20 - 0-A	99354076	915	24-Aug-99	X	X	X
GP-20 - 1-A	99354077	930	24-Aug-99	X	X	
GP-21 - 0-A	99344182	1510	8/19/99?	X	X	
GP-22 - 0-P	99344160	1330	17-Aug-99	X	X	
GP-22 - 0-A	99344161	1435	17-Aug-99	X	X	
GP-23 - 0-A	99354067	850	23-Aug-99	X	X	X
GP-24 - 0-A	99354078	1125	24-Aug-99	X	X	X
GP-25 - 0-P	99344169	1250	18-Aug-99	X	X	
GP-25 - 0-A	99344170	1420	18-Aug-99	X	X	
GP-26 - 0-P	99354053	855	22-Aug-99	X	X	
GP-26 - 0-A	99354054	950	22-Aug-99	X	X	
GP-27 - 0-P	99354084	1420	25-Aug-99	X	X	

Table 4—Frontier Hard Chrome—Groundwater Sampling Analysis Summary

WESTON Sample ID	EPA Sample ID	Time	Date	Selected Volatile Organic Compounds	Dissolved Chromium and Iron	Volatile Organic Compounds
				Region 10 ESAT SOP #FASP-041	EPA Method 6010	EPA Method 8260A
GP-27 - 0-A	99354085	1524	25-Aug-99	X	X	
GP-28 - 0-A	99354086	1710	25-Aug-99	X	X	
GP-29 - 0-A	99354087	904	25-Aug-99	X	X	
Equipment Rinsate	99354066	1913	22-Aug-99	X	X	
Equipment Rinsate	99354075	730	24-Aug-99	X	X	
Decon Water Drums	99354088	1000	26-Aug-99	X	X	

**Table 5—Frontier Hard Chrome—Chromium and Iron
Concentrations in Subsurface Soil (mg/kg)**

WESTON Sample ID	Sample Depth (feet bgs)	EPA Sample ID	Soil Unit Sampled	Hexavalent Chromium	Total Chromium	Total Iron
GP-02 P	15.5	99344163	Fill	6.23 U	37.4	10,600
GP-02 S	16.0	99344164	Silt	7.17 NU	25.0	22,600
GP-02 S (dup)	16.0	99344164	Silt		25.4	22,700
GP-05 P	16.5	99354055	Fill	1,015 J	4,820	11,200
GP-05 S	17.0	99354056	Silt	1,018 N	10,300	30,800
GP-06 P	3.5	99344162	Fill	3,498 N	5,150	13,000
GP-06 P (dup)	3.5	99344162	Fill	3,561 N		
GP-06 P	15.0	99344154	Fill	170	9,170	27,900
GP-06 S	16.0	99344155	Silt	1,468 N	10,100	34,200
GP-07 P	14.0	99344150	Fill	37.9	1,920	40,400
GP-07 P (dup)	14.0	99344150	Fill	36.9		
GP-07 S	15.5	99344151	Silt	5.74 NU	325	33,200
GP-07 S (dup)	15.5	99344151	Silt	7.15 NU		
GP-10 S	16.5	99354063	Silt	19.7 N	4,540	29,600
GP-10 P	17.5	99354062	Fill	22.8 J	1,490	10,800
GP-11 P	17.5	99354059	Fill	25.5 N	606	24,500
GP-11 S	18.0	99354060	Silt	6.82 NU	258	27,500
GP-11 S (dup)	18.0	99354060	Silt		255	25,000
GP-12 P (dup)	15.0	99344171	Fill	1,060 N		
GP-12 P (field dup)	15.0	99344172	Fill	814 N	12,300	32,800
GP-12 P	15.0	99344171	Fill	1,025 N	12,600	34,200
GP-12 S	15.5	99344173	Silt	2,550 N	12,900	25,000
GP-22 P (dup)	12.5	99344158	Fill	34.0		
GP-22 P	12.5	99344158	Fill	33.6	1,420	11,400
GP-22 S	13.0	99344159	Silt	64.2 N	6,710	28,200
GP-26 P (dup)	17.0	99354050	Fill	2,148 J		
GP-26 P (field dup)	17.0	99354052	Fill	2,668 J	9,080	13,800
GP-26 P	17.0	99354050	Fill	1,729 J	8,360	13,500
GP-26 S	17.5	99354051	Silt	7,506 N	31,800	29,200

Notes:

bgs: below ground surface

J: The analyte was positively identified. The reported result is an estimate.

N: Matrix interferences may be present. The reported result is an estimate.

U: The analyte was not detected at or above the reported result.

**Table 6—Frontier Hard Chrome—Filtered Chromium and Iron Concentrations
in Groundwater (µg/L)**

WESTON Sample ID [#]	Sample Depth Interval (feet bgs)	EPA Sample ID	Chromium	Iron
GP-01 P	12-16	99344167	5.7	1,020
GP-01 A	22-26	99344168	5.0 U	4,140
GP-02 P	11.5-15.5	99344165	5.0 U	780
GP-02 A	22-26	99344166	5.0 U	11,300
GP-02 P (dup)	11.5-15.5	99344165	5.0 U	790
GP-03 A	24-28	99354081	5.0 U	73.3
GP-03 A (dup)	24-28	99354081	5.0 U	73.4
GP-04 P	12-16	99344176	27.7	269
GP-04 A	22-26	99344177	5.0 U	64,600
GP-05 P	13-17	99354057	6,370	18
GP-05 A	22-26	99354058	12	22,400
GP-06 P	12-16	99344156	48,700	45.0
GP-06 A	22-26	99344157	25,600	144.0
GP-07 P (1st)*	11.5-15.5	99344152	85,600*	382,000*
GP-07 P (1st)	11.5-15.5	99344199	26.7	119
GP-07 A (1st)	20-24	99344153	12 U	103
GP-07 A (dup, 1st)	20-24	99344153	10 U	94.4
GP-07 P (2nd)	11.5-15.5	99354082	8.1	60.2
GP-07 A (2nd)	20-24	99354083	13	106
GP-08 A	24-28	99354080	5.0 U	435
GP-09 P	12-16	99344178	53.1	356
GP-09 A	22-26	99344179	5.0 U	1,590
GP-09 P (dup)	12-16	99344178	53.7	429
GP-10 P	13-17	99354064	77.0	187
GP-10 A	24-28	99354065	5.0 U	3,240
GP-10 P (dup)	13-17	99354064	79.4	187
GP-10 A (dup)	24-28	99354065	5.0 U	3,230
GP-11 A	22-26	99354061	5.0 U	2,430
GP-12 P	11.5-15.5	99344174	32,700	16
GP-12 A	22-26	99344175	30,000	76.6
GP-13 A	24-28	99354073	14	3,810
GP-14 P	12-16	99344180	15	112
GP-14 A	22-26	99344181	6.8	1,260
GP-15 P	8-12	99354070	5.9	274
GP-15 A	24-28	99354072	21,000	68.1
GP-15 A (dup)	24-28	99354071	23,000	88.0
GP-16 A	22-26	99344183	6,550	54.5
GP-16 A	22-26	99344184	6,830	10 U
GP-17 A	17-21	99354079	1,450	99.6
GP-18 A	14-18	99344185	5.0 U	330
GP-19 P	8-12	99354068	357	191
GP-19 A	24-28	99354069	10,900	43.7
GP-20 A	24-28	99354076	4,140	115
GP-20 A	24-28	99354077	4,540	25.8
GP-20 A (dup)	24-28	99354077	4,520	27.2

**Table 6—Frontier Hard Chrome—Filtered Chromium and Iron Concentrations
in Groundwater (µg/L)**

WESTON Sample ID [#]	Sample Depth Interval (feet bgs)	EPA Sample ID	Chromium	Iron
GP-21 A	22-26	99344182	13	1,020
GP-22 P	9-13	99344160	22.1	150
GP-22 A	18-22	99344161	6.9	139
GP-22 P (dup)	9-13	99344160	22.0	156
GP-23 A	24-28	99354067	5.0 U	134
GP-24 A	24-28	99354078	1,420	69.6
GP-25 P	20-24	99344169	5.0 U	132
GP-25 A	25-29	99344170	5.1 U	234
GP-25 P (dup)	20-24	99344169	5.0 U	127
GP-26 P	13.5-17.5	99354053	12,600	10 U
GP-26 A	22-26	99354054	119,000	11
GP-27 P	12.5-16.5	99354084	10	1,060
GP-27 A	24-28	99354085	277	25.4
GP-28 A	24-28	99354086	8,090	140
GP-29 A	24-28	99354087	2,450	68.9

Notes:

[#] GP-01 P: Sample from perched groundwater zone at station GP-01;

GP-01 A: Sample from "A" aquifer zone at station GP-01.

* Unfiltered sample

bgs: below ground surface

U: The analyte was not detected at or above the reported result.

Table 7—Frontier Hard Chrome—Concentrations of Field Laboratory Volatile Organic Compounds in Groundwater µg/L)

WESTON Sample ID*	EPA Sample ID	trans-1,2-Dichloroethene	cis-1,2-Dichloroethene	Trichloroethene	Tetrachloroethene
GP-01 A	99344168	10 UF	10 UF	0.2 UF	0.20 UF
GP-01 P	99344167	1.0 UF	1.7 F	1.6 F	2.4 F
GP-02 A	99344166	10 UF	10 UF	0.20 UF	0.20 UF
GP-02 P	99344165	10 UF	10 UF	0.20 UF	0.35 F
GP-03 A	99354081	1.0 UF	2.2 F	0.20 F	0.95 F
GP-04 A	99344177	1.0 UF	1.0 UF	0.12 F	0.43 F
GP-04 P	99344176	1.0 UF	1.0 UF	0.45 F	1.7 F
GP-05 A	99354058	1.0 UF	1.0 UF	0.04 F	0.11 F
GP-05 P	99354057	1.0 UF	1.1 F	0.86 F	1.8 F
GP-06 A	99344157	10 UF	10 UF	1.6 F	14 F
GP-06 P	99344156	10 UF	10 UF	0.52 F	20 F
GP-07 A (1st)	99344153	10 UF	15 F	0.68 F	6.7 F
GP-07 A (2nd)	99354083	1.2 F	14 F	0.44 F	0.34 F
GP-07 P (2nd)	99354082	1.0 UF	7.6 F	2.1 F	1.3 F
GP-07 P (dup, 2nd))	99354082	1.0 UF	7.8 F	2.3 F	1.7 F
GP-08 A	99354080	1.0 UF	1.0 UF	0.15 F	1.5 F
GP-09 A	99344179	1.0 UF	1.0 UF	0.02 UF	0.02 UF
GP-09 P	99344178	1.0 UF	1.0 UF	0.33 F	1.4 F
GP-09 P (dup)	99344178	1.0 UF	1.0 UF	0.31 F	1.2 F
GP-10 A	99354065	1.0 UF	1.0 UF	0.055 F	0.058 F
GP-10 P	99354064	1.0 UF	1.0 UF	0.39 F	0.97 F
GP-11 A	99354061	10 UF	10 UF	0.20 UF	0.20 UF
GP-12 A	99344175	10 UF	10 UF	0.21 F	1.2 F
GP-12 P	99344174	10 UF	10 UF	0.43 F	14.0 F
GP-12 P (dup)	99344174	1.0 UF	1.0 UF	0.42 F	13.7 F
GP-13 A	99354073	1.0 UF	1.3 F	0.22 F	1.2 F
GP-13 A	99354074	1.0 UF	1.2 F	0.18 F	0.68 F
GP-14 A	99344181	1.0 UF	5.9 F	0.22 F	0.037 F
GP-14 P	99344180	10 UF	10 UF	0.20 UF	0.20 UF
GP-15 A	99354072	1.0 UF	1.0 UF	0.49 F	2.2 F
GP-15 A (dup)	99354072	10 UF	10 UF	0.49 F	2.0 F
GP-15 P	99354070	1.0 UF	1.0 UF	0.19 F	1.2 F
GP-16 A	99344183	1.0 UF	1.0 UF	0.23 F	4.0 F
GP-16 A	99344184	1.0 UF	1.0 UF	0.25 F	4.4 F
GP-17 A	99354079	1.0 UF	2.4 F	0.54 F	1.7 F
GP-18 A	99344185	1.0 UF	1.4 F	0.08 F	0.02 UF
GP-19 A	99354069	1.0 UF	0.97 JF	0.63 F	3.6 F
GP-19 P	99354068	1.0 UF	1.0 UF	0.11 F	1.5 F
GP-20 A	99354076	1.0 UF	1.0 UF	0.37 F	2.1 F
GP-20 A	99354077	1.0 UF	1.0 UF	0.33 F	1.6 F
GP-21 A	99344182	1.0 UF	1.0 UF	0.80 F	0.68 F
GP-22 A	99344161	10 UF	10 UF	0.20 UF	0.20 UF
GP-22 P	99344160	10 UF	10 UF	0.68 F	1.1 F
GP-23 A	99354067	1.0 UF	1.0 UF	0.11 F	3.7 F
GP-24 A	99354078	1.0 UF	1.0 UF	0.22 F	2.5 F
GP-25 A	99344170	1.0 UF	1.0 UF	0.19 JF	2.0 F
GP-25 P	99344169	1.0 UF	1.0 UF	0.06 F	0.08 F

Table 7—Frontier Hard Chrome—Concentrations of Field Laboratory Volatile Organic Compounds in Groundwater µg/L)

WESTON Sample ID*	EPA Sample ID	trans-1,2-Dichloroethene	cis-1,2-Dichloroethene	Trichloroethene	Tetrachloroethene
GP-26 A	99354054	1.0 UF	1.9 F	0.26 F	0.58 F
GP-26 P	99354053	1.0 UF	1.1 F	1.2 F	2.4 F
GP-27 A	99354085	1.0 UF	9.5 F	0.71 F	0.43 F
GP-27 P	99354084	1.0 UF	1.6 F	0.57 F	4.8 F
GP-28 A	99354086	2.2 F	39 F	5.4 F	7.8 F
GP-29 A	99354087	1.0 UF	1.1 F	0.36 F	1.5 F

Notes:

* GP-01 P: Sample from perched groundwater zone at station GP-01; GP-01 A: sample from "A" aquifer zone at station GP-01.

F: The result was acquired by field screening methods.

J: The analyte was positively identified. The associated numerical result is an estimate.

U: The analyte was not detected at or above the reported result.

Table 8—Frontier Hard Chrome—Confirmation Volatile Organic Compound Concentrations in Groundwater (µg/L)

WESTON Sample ID*	EPA Sample ID	1,1,1- Trichloroethane	1,1- Dichloroethane	cis-1,2- Dichloroethene	1,2- Dichloroethene	Trichloroethene	Trichloromethane	Tetrachloroethene
GP-08 A	99354080	1.0 U	0.58 J	0.18 J	1.0 U	1.0 U	1.0 U	0.83 J
GP-10 P	99354064	0.18 J	0.38 J	0.52 J	1.0 U	0.51 J	1.0 U	1.7
GP-14 A	99344181	1.0 U	1.8	6.0	0.23 J	0.21 J	1.0 U	1.0 U
GP-16 A	99344184	5.0	2.1	0.23 J	1.0 U	0.17 J	1.0 U	3.0
GP-17 A	99354079	3.0	2.4	2.1	1.0 U	0.52 J	1.0 U	1.5
GP-19 A	99354069	3.4	1.7	0.84 J	1.0 U	0.45 J	1.0 U	1.7
GP-20 A	99354076	2.7	1.6	0.60 J	1.0 U	0.29 J	1.0 U	1.4
GP-23 A	99354067	0.36 J	0.17 J	1.0 U	1.0 U	1.0 U	0.12 J	3.8
GP-24 A	99354078	1.1	0.63 J	0.20 J	1.0 U	0.19 J	1.0 U	3.2

Notes:

* GP-10 P: Sample from perched groundwater zone at station GP-10; GP-08 A: sample from "A" aquifer zone at station GP-08.

J: The analyte was positively identified. The associated numerical result is an estimate.

U: The analyte was not detected at or above the reported result.

Table 9—Frontier Hard Chrome—Field Laboratory versus Confirmation VOC Analytical Results for Groundwater Samples (µg/L)

WESTON Sample ID*	EPA Sample ID	cis-1,2-Dichloroethene					trans-1,2-Dichloroethene					Trichloroethene					Tetrachloroethene				
		Field		Confirm	RPD		Field		Confirm	RPD		Field		Confirm	RPD		Field		Confirm	RPD	
GP-08 A	99354080	1.0	UF	0.18	J	NA	1.0	UF	1.0	U	NA	0.15	F	1.0	U	NA	1.5	F	0.83	J	58
GP-10 P	99354064	1.0	UF	0.52	J	NA	1.0	UF	1.0	U	NA	0.39	F	0.51	J	27	0.97	F	1.7		55
GP-14 A	99344181	5.9	F	6.0		2	1.0	UF	0.23	J	NA	0.22	F	0.21	J	5	0.037	F	1.0	U	NA
GP-16 A	99344184	1.0	UF	0.23	J	NA	1.0	UF	1.0	U	NA	0.25	F	0.17	J	38	4.4	F	3.0		38
GP-17 A	99354079	2.4	F	2.1		13	1.0	UF	1.0	U	NA	0.54	F	0.52	J	4	1.7	F	1.5		13
GP-19 A	99354069	0.97	JF	0.84	J	14	1.0	UF	1.0	U	NA	0.63	F	0.45	J	33	3.6	F	1.7		72
GP-20 A	99354076	1.0	UF	0.60	J	NA	1.0	UF	1.0	U	NA	0.37	F	0.29	J	24	2.1	F	1.4		40
GP-23 A	99354067	1.0	UF	1.0	U	NA	1.0	UF	1.0	U	NA	0.11	F	1.0	U	NA	3.7	F	3.8		3
GP-24 A	99354078	1.0	UF	0.20	J	NA	1.0	UF	1.0	U	NA	0.22	F	0.19	J	15	2.5	F	3.2		25

Notes:

* GP-10 P: Sample from perched groundwater zone at station GP-10; GP-08 A: sample from "A" aquifer zone at station GP-08.

RPD: Relative Percent Difference

F: The result was acquired by field screening methods.

J: The analyte was positively identified. The associated numerical result is an estimate.

U: The analyte was not detected at or above the reported result.

APPENDIX A
SOIL BORING LOGS

Push-Probe GP-02

PROJECT Frontier Hard Chrome Plume Characterization
 DATE COMPLETED 18 August 1999
 DRILLING METHOD Push-Probe
 TOP OF CASING NA
 GROUND SURFACE ELEV NA
 LOGGED BY S. Fernandez

Depth (ft)	PID Reading	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USC Classification	Lithological Description	
0						SW SM	SAND with SILT and GRAVEL (SW-SM), Reddish brown (7.5y 4/2), fine grained sand, subangular, 1-2 cm gravel, dry, no stain or odor.	0
						SP	Poorly Graded SAND (SP), Dark grayish brown (2.5y 4/2), 100% sand, medium grained, subangular, dry, no stain or odor.	
5							SAA	5
							SAA	
10								10
		GWR5-GP-02-0-P VOCs, Diss. Cr						
15							Wet, perched zone.	15
		SBR5-GP-02-0-P Cr, Fe, Cr6+ SBR5-GP-02-0-S Cr, Fe, Cr6+				ML	Clayey SILT (ML), Very dark gray (5y 3/1), 100% fines, moist, high plasticity, roots, iron oxide staining along roots no odor.	
20						SW SM	SAND with SILT and GRAVEL (SW-SM), Olive gray (5y 4/2), 30% gravel, 60% sand, 10% fines, fine to medium grained sand, 4-5 cm basaltic and quartz gravel, wet, no stain or odor.	20
		GWR5-GP-02-0-A VOCs, Diss. Cr						
25								25
							BOH at 26'	
30							Notes: 1. BOH = Bottom of hole 2. Sample color referenced to Munsell Soil Color Chart 3. SAA = Same as above	30

PLATE

Push-Probe GP-05

PROJECT Frontier Hard Chrome Plume Characterization

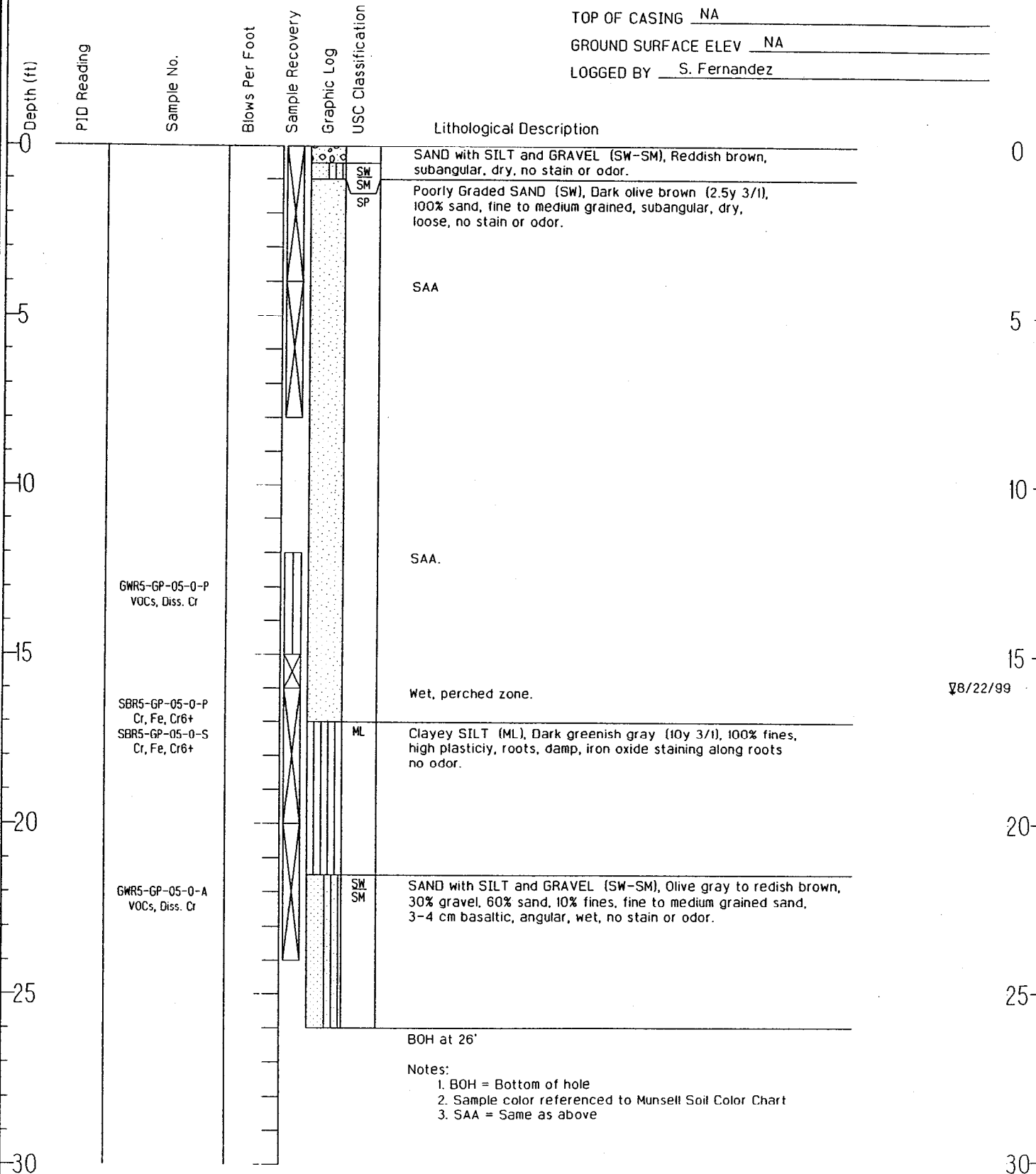
DATE COMPLETED 22 August 1999

DRILLING METHOD Push-Probe

TOP OF CASING NA

GROUND SURFACE ELEV NA

LOGGED BY S. Fernandez



Notes:

1. BOH = Bottom of hole
2. Sample color referenced to Munsell Soil Color Chart
3. SAA = Same as above

PLATE

Push-Probe GP-06

PROJECT Frontier Hard Chrome Plume Characterization

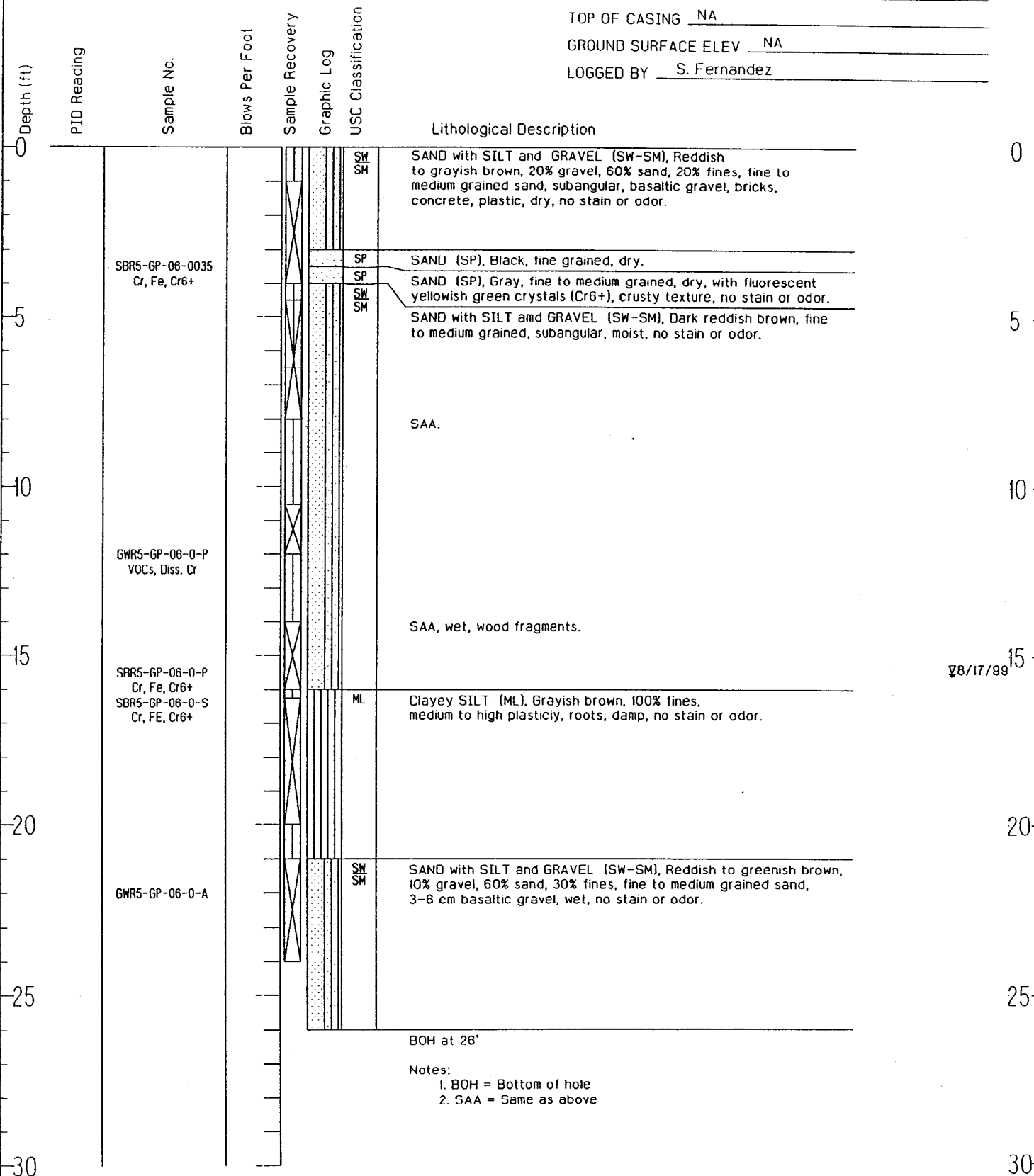
DATE COMPLETED 17 August 1999

DRILLING METHOD Push-Probe

TOP OF CASING NA

GROUND SURFACE ELEV NA

LOGGED BY S. Fernandez



8/17/99

PLATE

Push-Probe GP-07

PROJECT Frontier Hard Chrome Plume Characterization
 DATE COMPLETED 16 August 1999
 DRILLING METHOD Push-Probe
 TOP OF CASING NA
 GROUND SURFACE ELEV NA
 LOGGED BY S. Fernandez

Depth (ft)	PID Reading	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USC Classification	Lithological Description	
0						SW SM	SAND with SILT and GRAVEL (SW-SM), Reddish to black brown, 20% basaltic gravel, 60% sand, 20% fines, brick, metal fragments, nails, plastic, dry, no stain, unusual odor (cannot identify).	0
5							SAA.	5
10							SAA.	10
15		GWR5-GP-07-0-P VOCs, Diss. Cr					SAA	15 8/16/99
		SBR5-GP-07-0-P Cr, Fe, Cr6+ SBR5-GP-07-0-S Cr, Fe, Cr6+					Wet, perched zone.	
20						ML	Clayey SILT (ML), Very dark brown, 100% fines, high plasticity, roots, moist to damp, iron oxide staining along roots, no odor.	20
25		GWR5-GP-07-0-A VOCs, Diss. Cr				SW SM	SAND with SILT and GRAVEL (SW-SM), Reddish brown, 10% gravel, 60% sand, 30% fines, fine to medium grained sand, basaltic gravel, wet, no stain or odor.	25
30							BOH at 24'	30

Notes:
 1. BOH = Bottom of hole
 2. SAA = Same as above

PLATE

Push-Probe GP-10

PROJECT Frontier Hard Chrome Plume Characterization

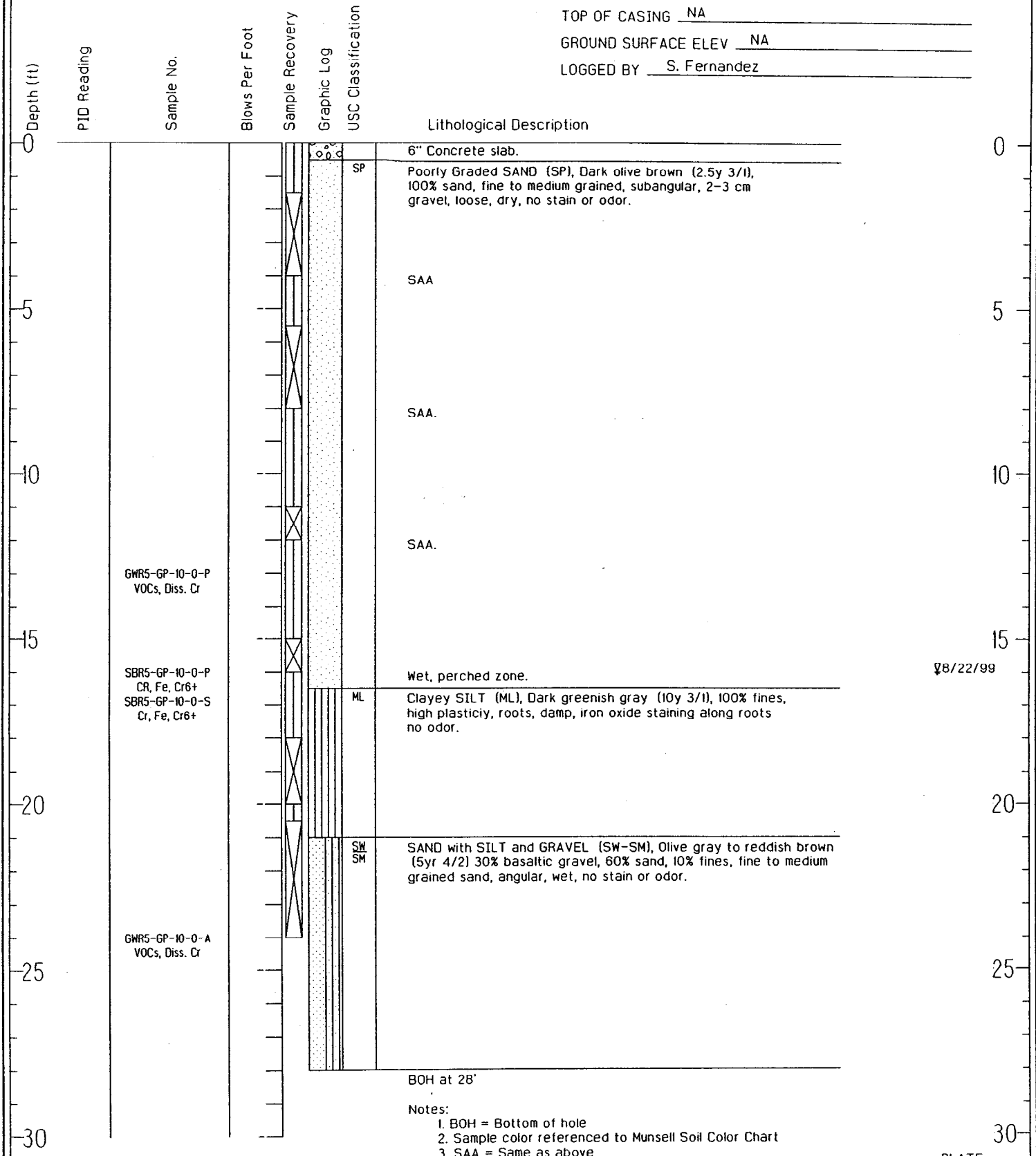
DATE COMPLETED 22 August 1999

DRILLING METHOD Push-Probe

TOP OF CASING NA

GROUND SURFACE ELEV NA

LOGGED BY S. Fernandez



Push-Probe GP-11

PROJECT Frontier Hard Chrome Plume Characterization
 DATE COMPLETED 22 August 1999
 DRILLING METHOD Push-Probe
 TOP OF CASING NA
 GROUND SURFACE ELEV NA
 LOGGED BY S. Fernandez

Depth (ft)	PID Reading	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USC Classification	Lithological Description
0							6" Concrete slab
						SW SM	SAND with SILT and GRAVEL (SW-SM), Dark brown, 30% basaltic gravel, 60% sand, 10% fines, fine grained sand, angular, wood, concrete, bricks, asphalt dry, loose, no stain or odor.
5							SAA.
		SBR5-GP-11-0-P Cr, Fe, Cr6+ SBR5-GP-11-0-S Cr, Fe, Cr6+					Wood and asphaltic material, damp, no odor.
10						ML	Clayey SILT (ML), Dark olive gray, 100% fines, high plasticity, roots, dry to damp, iron oxide staining along roots, no odor.
15							
20							
		GWR5-GP-11-0-A VOCs, Diss. Cr				SW SM	SAND with SILT and GRAVEL (SW-SM), Reddish brown, 30% gravel, 60% sand, 10% fines, fine to medium grained sand, angular, wet, no stain or odor.
25							
30							BOH at 26'

Notes:
 1. BOH = Bottom of hole
 2. SAA = Same as above

PLATE

Push-Probe GP-12

PROJECT Frontier Hard Chrome Plume Characterization

DATE COMPLETED 18 August 1999

DRILLING METHOD Push-Probe

TOP OF CASING NA

GROUND SURFACE ELEV NA

LOGGED BY S. Fernandez

Depth (ft)	PID Reading	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USC Classification	Lithological Description	
0							6" Concrete slab.	0
						SW-SM	SAND with SILT and GRAVEL (SW-SM), Dark brown, fine to medium grained sand, angular, 4-5 cm basaltic gravel, concrete, bricks, asphalt, dry, loose, no stain or odor.	
5							SAA.	5
							SAA.	
10								10
		GWR5-GP-12-0-P VOCs, Diss. Cr						
15		SBR5-GP-12-0-P Cr, Fe, Cr6+ SBR5-GP-12-0-S Cr, Fe, Cr6+				ML	Wet, perched zone. Clayey SILT (ML), Dark olive gray, 100% fines, high plasticity, roots, dry to damp, roots, iron oxide staining along roots, no odor.	15
20						SW-SM	SAND with SILT and GRAVEL (SW-SM), Reddish brown, 30% gravel, 60% sand, 10% fines, fine to medium grained sand, 4-5 cm basaltic gravel, angular, wet, no stain or odor.	20
		GWR5-GP-12-0-A VOCs, Diss. Cr						
25								25
30							BOH at 26'	30

Notes:

1. BOH = Bottom of hole
2. SAA = Same as above

PLATE

Push-Probe GP-22

PROJECT Frontier Hard Chrome Plume Characterization
 DATE COMPLETED 17 August 1999
 DRILLING METHOD Push-Probe
 TOP OF CASING NA
 GROUND SURFACE ELEV NA
 LOGGED BY S. Fernandez

Depth (ft)	PID Reading	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USC Classification	Lithological Description	
0						SP	Poorly Graded SAND (SP), Dark gray (5y 4/1), 100% sand, fine to medium grained, subangular, loose, dry, no stain or odor.	0
5							SAA	5
10		GWR5-GP-22-0-P VOCs, Diss. Cr					SAA.	10
							Wet, perched zone.	
15		SBR5-GP-22-0-P Cr, Fe, Cr6+ SBR5-GP-22-0-S Cr, Fe, Cr6+				ML	SILT with CLAY (ML), Olive gray (5y 4/2), 100% fines, medium to high plasticity, wet, no stain or odor.	15
20		GWR5-GP-22-0-A VOCs, Diss. Cr				ML	Clayey SILT with GRAVEL (ML), Olive gray (5y 4/2), 20% basaltic gravel, 80% fines, medium to low plasticity 1-2 cm gravel, angular, wet, no stain or odor.	20
25							BOH at 22'	25
30							Notes: 1. BOH = Bottom of hole 2. Sample color referenced to Munsell Soil Color Chart 3. SAA = Same as above	30

PLATE

Push-Probe GP-26

PROJECT Frontier Hard Chrome Plume Characterization

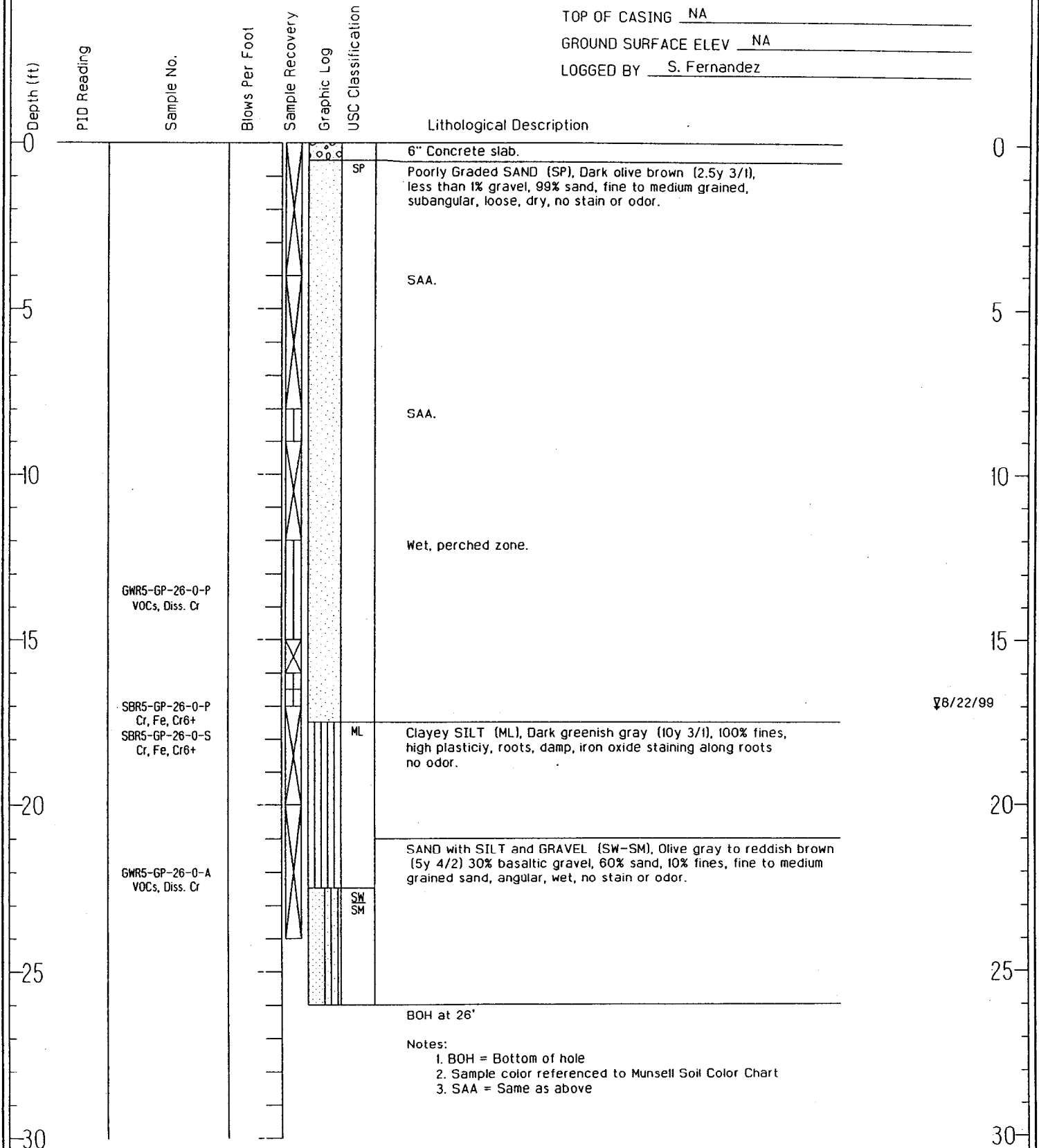
DATE COMPLETED 22 August 1999

DRILLING METHOD Push-Probe

TOP OF CASING NA

GROUND SURFACE ELEV NA

LOGGED BY S. Fernandez



7/8/22/99

PLATE